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Differences in Approach and Avoidance Motivation Sensitivities Predicting Participation and Performance in Strength Sport

ABSTRACT

Gray's Reinforcement Sensitivity Theory proposes that individual differences in behavior are due to sensitivity to two brain systems: the Behavioral Inhibition System (BIS), which regulates aversive emotions to threatening stimuli, and the Behavioral Approach System (BAS), which regulates positive emotions towards rewarding or non-punishing stimuli. The current study investigated whether BIS and BAS sensitivity predicts participation and performance in strength sports. A sample of 177 competitive strength athletes (male = 148; female = 29; mean age = 28.68; SD = 6.24 years) and 178 control participants (male = 89; female = 89; mean age = 29.39; SD =7.42) completed the BIS/BAS scale, with strength athletes also providing their Wilks scores as a measure of sporting performance. Independent t-tests showed significantly higher BIS (MD = 2.37, p=0.003, 95% CI [0.79, 3.94] d=0.31) and total BAS (MD = 11.71, p<0.001, 95% CI [9.26, 14.15] d=1.00) sensitivity in strength athletes than individuals in the control group. A 3-step hierarchical regression analysis revealed that the number of training years (β=0.506, p<.001), BIS (β=-203, p=.005) and BAS Drive (β=.188, p=.012) made significant unique contributions to predicting Wilks score, with no significant contributions of age, sex, BAS Fun Seeking, and BAS Reward Responsiveness. The findings indicate that the overall reward sensitivity (total BAS score) and reward seeking (BAS drive) are associated positively with participation and performance in strength sports, respectively. Given the association of these brain systems to addiction and other psychiatric disorders, the findings could have implications in psychiatric treatment and sporting recruitment.

Keywords: Behavioral inhibition, Behavioral activation, Strength Performance, Motivation

INTRODUCTION

It is estimated that 34% of men and 42% of women in the United Kingdom currently have inactive lifestyles, which increases the risk of developing cardiovascular disease, various cancers, or type 2 diabetes (25). Physical activity is driven by motivation, reinforced by positive emotions such as enjoyment and fulfilment that results from participation and performance in the activity (19). For example, intrinsic motivation to exercise has been positively associated with enjoyment and participation among people who regularly undertake CrossFit sessions and traditional resistance training (21). This finding suggests the possibility that individuals with higher sensitivity to their body's reward system are more likely to pursue sports due to increased positive affect that results from participating in the exercise. To examine this possibility, the present study investigated the associations between the reward sensitivity of individuals and their sport participation and performance. We examined whether there were differences in reward sensitivity between those who participate in strength sports and those who do not, and whether reward sensitivity predicts performance of strength athletes.

Gray's Reinforcement Sensitivity Theory (10) proposes that the differences in sensitivity to punishing and reinforcing stimuli correspond to the degrees of anxiety and impulsivity of individuals. These emotional and behavioral traits reflect three neural systems. The first system is named the Behavior Inhibition System (BIS). This mechanism responds to aversive cues in the environment and causes frustration, anxiety, or sadness, which prevents individuals from experiencing life-threatening situations. The second system is named the Behavioral Approach System (BAS). This mechanism produces positive emotions that incentivize individuals to seek and approach rewarding stimuli. Following Gray's proposal, BAS sensitivity was divided into three subcategories (3): BAS Drive, the motivation to repeatedly seek rewards; BAS Reward Responsiveness, positive responses to the prospective of rewards; and BAS Fun Seeking, the desire for rewards and willingness to approach a

potentially rewarding event. These subcategories are often collated to measure individuals' overall sensitivity to rewards (BAS sensitivity). The third system is named the fight/flight system. This mechanism gives rise to escape reactions and defensive aggression to punishing stimuli. Gray suggested that the fight/flight system is more closely related to biological reactions of the autonomous nervous systems and is less cognitive than the other two systems.

BIS and BAS sensitivities have been linked to several psychopathological disorders. Research has shown that individuals with anxiety disorders demonstrate higher BIS sensitivity than control participants (2). Higher BAS total scores and BIS scores were associated with dysfunctional eating (20), bipolar disorder (22), and psychopathy (11, 13). High BAS sensitivity was also found to be associated with addictions, such as smart phone addictions (12), internet addiction (18), alcohol craving (5), and alcohol abuse (11, 13, 20), tobacco and cannabis use (27), pathological gambling (23), and clinically-referred drug addictions (1, 6). In addition to substance abuse, additional high-risk behavior has been attributed to BAS sensitivity, positively relating to engagement in dangerous extreme sports (4, 26). Although previous research has focused on the adverse implications of heighted BAS sensitivity, increased levels of sensitivity to reward may also be related to participation (4, 21, 26) and performance in sports as BAS Drive has been found to be correlated positively with entrepreneurial action (17). Because the BAS system is responsible for approach motivation, heightened BAS sensitivity for extreme sport athletes and entrepreneurs may result from an increase in the experience of positive affect from these activities rather than risk-seeking behavior. Therefore, the current study investigated positive outcomes of heightened BAS sensitivity.

As the BAS system is responsible for approach motivation, it may also underpin increased participation and better performance in sports. If individuals are sensitive to rewards, they may be motivated to engage with sports for potential rewards and continue the engagement for a longer period. They may also maintain a high level of engagement with sports and achieve better performance. The present study examined these possibilities in the context of strength sports. We

focused on strength athletes for two primary reasons. Firstly, strength sports are predominantly classified as so called “individual sports”, thus facilitating the opportunity to measure the impact of an individual’s personal traits on participation and performance. Secondly, performance in strength sports is characterized predominantly by how much weight (kg) can be lifted, which provides an objective performance measure that can facilitate comparisons between individual athletes. As an objective measure of performance in strength sports, we used the Wilks coefficient (Table. 1), to calculate the Wilks score. Wilks score is calculated based upon the total weight lifted by the athlete, the athletes bodyweight, and biological sex, producing reliable inter-athlete comparisons (28). The present study tested two hypotheses. The first hypothesis was that strength athletes have higher BAS sensitivity than individuals in the control group who have not been involved in any strength sports, which would suggest that high reward sensitivity underlies participation in strength sports. The second hypothesis was that Wilks score is predicted by BAS sensitivity such that athletes with higher achievement tend to have higher BAS sensitivity, which would imply that reward sensitivity underlie performance in strength sports.

METHOD

EXPERIMENTAL APPROACH TO THE PROBLEM

This study used a between-subjects cross-sectional survey design to investigate the differences in BIS/BAS sensitivity between individuals who participate in strength sports and a control group of participants who do not, and whether BAS sensitivity predicted strength performance.

SUBJECTS

The sample comprised 177 competitive strength athletes and 178 control participants who had no current or prior involvement in strength sports. The inclusion criteria for the athlete group were that they had a minimum of two years’ experience attained in the sports of strongman or powerlifting. The athlete group comprised 148 males (age = 28.05 ± 6.16 years, body mass = 109.07 ± 21.40 kg,

years training = 4.11 ± 3.19 years) and 29 females (age = 31.90 ± 5.73 years, body mass = 85.47 ± 23.15 kg, years training = 3.09 ± 2.08 years). The control group comprised 89 males (age = 28.19 ± 6.80 years) and 89 females (age = 30.60 ± 7.84 years). All participants were aged between 18 and 50 years. Data were excluded if self-reported age was outside the target range. For the strength athlete group, data were also excluded if they reported having less than 2 years' experience, reported years of training exceeded their age (possibly, they reported in months rather than in years, but we excluded these participants to remove any ambiguity), or their Wilks score was below 0.

PROCEDURE

Before data were gathered, the Research Ethics Committee at the University of Essex granted ethics approval. Participants were recruited from social media platforms. Strength athletes were targeted through popular strongman and powerlifting groups on Facebook and Instagram. Participants for the control group were also recruited through popular Facebook groups unrelated to sports, specifying the requirement for no prior or current involvement in strength sports. Participants completed an online survey on Qualtics (Provo, UT, USA) using their own personal electronic devices. The survey initially displayed information about the study and required participants' consent to proceed. Participants provided their age and sex before completing the BIS/BAS Likert scale (3). After completion of the scale, participants were asked if they were training for powerlifting or strongman competitions. If the participant answered 'no,' they were presented with a closing screen and classified as a 'control' participant. Those who answered 'yes' were classified as a 'strength athlete' and asked to detail how many years they had been training, their one repetition maximum (1RM) in kilograms for the squat, bench press, and deadlift and to report their heaviest bodyweight from when they performed the given lifts. Participants were required only to submit lifts that would be technically acceptable in their chosen sports, excluding any they had completed using compressive lifting suits. Such equipment is commonly used in strength sports and can enable an athlete to achieve significantly greater strength performance (29).

MEASURES

BIS/BAS SCALE

To measure individual differences in BIS/BAS sensitivity, we used the self-report BIS/BAS scale (3). The questionnaire is comprised of twenty-four questions, with seven of these assessing BIS and thirteen assessing BAS (four for BAS Drive and BAS Fun Seeking, and five for BAS Reward Responsiveness). The additional four questions are filler items. Participants responded on a 4-point Likert scale, with high numbers indicating higher levels of sensitivity. The BIS/BAS scale has been validated using behavior studies (3) and electroencephalogram studies (24).

WILKS SCORE

Performance in strength sport was measured using Wilks score coefficient (Table. 1), which has been consistently used in powerlifting federations, and shown to be a valid measure of ranking capabilities of powerlifters (28).

Statistical Analyses

We tested two hypotheses as stated in the Introduction. The first hypothesis was that BAS sensitivity was strength athletes have higher BAS sensitivity than individuals in the control group who had no involvement in any strength sports. To test this, a series of independent T-Tests were conducted to compare the mean scores on the BIS/BAS scales between the control and the strength athlete conditions. The independent variable for this analysis was participant group (strength athlete vs. control), and the dependent variables were the overall BIS/BAS scores and the BAS sub-scale scores. The second hypothesis was that Wilks score could be predicted by BAS sensitivity such that athletes with higher achievement tend to have higher BAS sensitivity. To test this hypothesis, a hierarchical regression analysis was conducted. The response variable was Wilks score among strength athletes. At the first step, the regression model included age, sex, and years trained as predictor variables. At

the second step, BIS score was added to the regression model. Finally, at the third step, the three BAS sub-scale scores were added.

RESULTS

Approach and avoidance sensitivity and participation in strength sports

The comparisons of BIS/BAS scores between strength athletes and control participants are summarized in Table 2. Strength athletes had significantly higher total BAS scores than the control participants (MD=11.71, 95% Cl [9.26, 14.15] 1-β=1.00). Strength athletes also had significantly higher BAS Drive (MD=0.98, 95% Cl [0.78, 1.20] 1-β=1.00), BAS Fun Seeking (MD=0.80, 95% Cl [0.59, 1.02] 1-β=1.00) and BAS Reward Responsiveness (MD=1.11, 95% Cl [0.89, 1.33] 1-β=1.00). Although this was not predicted from our hypothesis, strength athletes had significantly higher BIS sensitivity compared to the control participants (MD=2.37, 95% Cl [0.79, 3.94] 1-β=0.90).

Approach and avoidance sensitivity and performance in strength sports

To explore whether Wilks score (M= 383.12 SD= 77.92) was predicted by BIS/BAS scores, a hierarchical linear regression analysis was conducted. The formula and coefficients used to calculate Wilks scores are summarized in Table 1, and the results of the hierarchical regression analysis are summarized in Table 3. In Step 1, age, sex, and years training were entered in the regression model, and they explained 23.2% of the variance in Wilks' score (p<.001). In step 2, BIS score was added to the model, which accounted for an additional 4.5% of the variance in Wilks' score (p<.001). In step 3, BAS Fun Seeking, BAS Reward Responsiveness and BAS Drive were added to the model, which also accounted for an additional 3.9% of the variance in Wilks score (p =.024). In the final model, years training, BIS and BAS Drive were shown to have made significant independent contributions to Wilks score, and BAS Fun Seeking and BAS Reward Responsiveness were not shown to be reliable predictors of Wilks score.

DISCUSSION

This study investigated the associations between reward sensitivity and participation and performance in strength sports. According to Gray's Reinforcement Sensitivity theory, differences in sensitivity to punishment and reward correspond to anxiety and impulsivity (10) which are measured respectively with the BIS and BAS metrics. To examine the association between reward sensitivity and participation in strength sports, we tested whether BAS (and BIS) scores were greater for strength athletes than for control participants who were not involved in strength sports. To examine the association between reward sensitivity and performance in strength sports, we tested the association between BAS (and BIS) scores and Wilks scores in strength athletes. We found that strength athletes have significantly higher BAS sensitivity and BIS sensitivity than control participants. Furthermore, BIS sensitivity was negatively associated with Wilks score whereas BAS Drive was positively associated with Wilks score. These findings suggest that BAS sensitivity may influence individual differences in motivation to participate in strength sport, whereas a stronger tendency of persistent pursuit of rewards (BAS Drive) is related to improved performance within strength sports. Therefore, the present results support the proposal that reward sensitivity is closely related to participation and performance in strength sports.

The finding that strength athletes had greater BAS sensitivity than the control group is consistent with the idea that heightened sensitivity to rewards can lead to greater satisfaction from strength training and motivate continued participation in training. Increased BAS sensitivity has been shown to be positively associated with participation in extreme sports (4, 26), while greater levels of approach motivation has previously shown to increase commitment in various sports (30). Although the present study did not involve a direct measurement of commitment, the strength athletes were required to have at least two years of training experience demonstrating a long-term commitment to their sport. The present result thus implies that commitment to strength sports may be driven by increased reward sensitivity. The present study also demonstrates that strength athletes had greater

BIS sensitivity than participants in the control group. This suggests that strength athletes are more sensitive to negative emotions and potentially are more vulnerable to anxiety (2), and these individuals may be drawn to resistance training due to its anxiety-relieving effects (8).

Performance in strength sports were associated with high BAS Drive score and low BIS score. This is consistent with Lerner et al. (13) who found that these same traits predicted performance in entrepreneurial behaviors. This suggests that the traits associated with better performance in strength sports overlap with the predictors of performance in other seemingly unrelated domains. The negative association between BIS score and performance is contrasted to the positive association between BIS score and participation. Performance anxiety has been found to be negatively related to performance in competitive Olympic weightlifters (7). Hence, BIS sensitivity may motivate participation in strength sports, but performance may improve better when athletes are more resistant (insensitive) to anxiety-related cues in the environment. Furthermore, the present study found that BAS Drive, a trait previously associated with drug misuse (6) and smart phone addiction (12), predicted performance in strength sports. This suggests that leveraged in the correct way, those who are more susceptible to addiction could channel their high reward sensitivity into constructive tasks such as strength training or business activities and, as a result, potentially achieve higher achievements.

A potential implication of the current findings could be the adaptation of treatments in the field of psychiatry. Our results indicate that strength athletes share the same traits that previous research has found to predict addiction (e.g.,6, 12, 18). Research in psychiatry has reported that leisure boredom is associated with addiction and substance abuse (3, 29), while engagement in hobbies has been shown to significantly increase recovery-related optimism and life satisfaction in recovering addicts (20). Sport engagement can offer sustained, meaningful activities within the community, supportive social networks, and new identities (16), which are essential for abstinence (9). Sporting interventions have also been shown to reduce internet addiction (31) and alcohol misuse (14).

Nevertheless, there has been limited attempts to treat addictions through participation in sport (15). More investigations are required to evaluate the generalizability of the present findings beyond strength athletes and the methods to encourage individuals suffering from addictions to engage in sport training. Finally, the understanding that increased BAS and decreased BIS scores can predict performance could be utilized as a tool for coaches in strength sports. This could be used as a method to supplement recruitment processes, to aid in the identification of strength athletes with the optimal traits to achieve high performance.

Despite the novel findings, some limitations of the current study should be noted. First, only 16% of the strength athletes were female, compared to 50% of control participants. Future research should aim to match the demographics of both the strength athlete and control conditions. We only considered participants with competitive experience in either strongman or powerlifting. This raises the possibility that participants who strength train recreationally or participate in an alternate strength sport could be allocated as a control condition. Efforts were made through the advertisement process to ensure this would not happen. While advertising for strength athletes, we specified that we were seeking competitive strongman and powerlifters only. Additionally, when recruiting control participants, strength sports were not mentioned, and the participants were recruited from generic social media pages. Furthermore, Wilks score was the only measure of sporting performance used. Although it is a reliable measure for comparing powerlifters (28), it does not account for the wide variety of exercises that are executed in the sport of strongman. Future research could aim to repeat the present methods in Powerlifters only, allowing for more specific comparisons.

Conclusion

The results of this study supported the hypothesis that BAS sensitivity would influence participation in strength sports and that higher sensitivity in BAS Drive would predict performance. Unexpectedly, BIS sensitivity was also shown to influence participation in strength sports in addition to negatively

predicting performance. These findings indicate the positive effects of reward sensitivity that have previously been linked to addictions, but further investigations are required to examine whether the present results can be generalized beyond strength sport athletes. Further understanding of individuals' sensitivity to BIS and BAS could facilitate several positive outcomes such as aiding treatments for addiction and athlete recruitment in sports settings.

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Table 1. The formula and values used in the Wilks score coefficient

$$\text{(Squat 1RM + Bench Press 1RM+ Deadlift 1RM)} * \frac{500}{a+(b*bw)+(c*bw^2)+(d*bw^3)+(e*bw4)+(f*bw5)}$$

Value	Men	Women
a	-216.0475144	594.31747775582
b	16.2606339	−27.23842536447
c	-0.002388645	0.82112226871
d	-0.00113732	−0.00930733913
e	7.01863 × 10−6	4.731582 × 10−5
f	−1.291 × 10−8	−9.054 × 10−8
bw	Athlete's Bodyweight	Athlete's Bodyweight

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Table 2. Means and standard deviations BIS/BAS Scores for the Athlete and Control Conditions

BIS/BAS Score	Strength Athlete	Control	t(353)	p	d
BAS Total	39.14 (4.18)	27.43 (15.99)	9.45	<.001	1.00
BAS Drive	3.09 (0.55)	2.11 (1.29)	9.30	<.001	0.98
BAS Fun Seeking	2.96 (0.62)	2.16 (1.31)	7.36	<.001	0.78
BAS Reward Responsiveness	3.61 (0.31)	2.50 (1.44)	10.00	<.001	1.06
BIS Score	19.50 (4.41)	17.13 (9.70)	2.96	.003	0.31

Table 3. Hierarchical Regression Analysis Predicting Wilks' Score

	Standardized Coefficient		
Predictor Variables	*Regression 1*	*Regression 2*	*Regression 3*
Sex (1, Male; 0, Female)	0.004	-0.065	-0.050
Age	-0.076	-0.086	-0.078
Years Training	0.496***	0.506***	0.490***
BIS Score		-0.223**	-0.203**
BAS Drive			0.188*
BAS Fun Seeking			-0.079
BAS Reward Responsiveness			0.063
R^2	0.232***	0.278***	0.317***
R^2 Change	0.232***	0.044**	0.039*

*p<0.05; **p<0.01; ***p<0.001